

We claim:

1. A method for logging data written by a host computer to a local data storage system including a local array of data storage devices and a first array controller and a second array controller coupled to each other and also coupled between the host computer and the array, wherein the data is replicated on a remote storage system connected to the local data storage system by at least one link, the method comprising the steps of:
- storing, on a log unit in primary cache memory in the first array controller, the data and associated command for every write transaction that occurs between the host computer and the local array, wherein the primary cache is mirrored in backup cache memory in the second array controller;
 - sending the data to the remote storage system to create a remote copy; and
 - in the situation wherein the remote copy has not successfully completed and the first array controller has failed, then re-playing the data on the log unit by performing the steps of:
 - for each entry in the log unit mirrored in the backup cache:
 - reading the data from the backup cache for each said transaction in the log unit; and
 - writing the data to the remote storage system in transaction order.
2. The method of claim 1, including the additional step of sending the host computer a write completion status message prior to sending the data to the remote storage system.
3. The method of claim 1, wherein said writing step includes performing a transaction-order merging of the data on the log unit with the data previously stored on the remote storage system to return the data on the local data storage system and the remote storage system to a consistent data state.

1 4. The method of claim 3, including the additional steps of:
2 continuing to write said data from the host computer to the log unit
3 while said merging is being performed.

1 5. the method of claim 1, wherein said log unit comprises a storage set
2 considered as a logical unit by the array controller.

1 6. the method of claim 1, wherein the data written by the host computer is
2 stored in cache memory in the first array controller in transaction order.

1 7. The method of claim 1, wherein the second array controller
2 communicates with the first controller to determine when the first array controller
3 fails.

1 8. The method of claim 1, wherein the data written by the host computer is
2 written in asynchronous mode.

1 9. The method of claim 1, wherein the remote storage system is unavailable
2 due to a situation wherein either said at least one link has failed, the remote site is
3 down, or a site failover has occurred.

1 10. A method for merging data, written by a host computer to a local data
2 storage array with a backup copy of the data written to a remote storage system,
3 after a first array controller for the local storage system has been inaccessible for a
4 period of time, wherein both the first array controller and a second array controller
5 are coupled to each other and to the local data storage array, the method comprising
6 the steps of:

7 storing the data for each write transaction from the host computer in
8 mirrored cache memory in both the first array controller and the second array
9 controller;

10 storing command information including the LBN extent associated with the
11 data in a log in mirrored cache memory in both the first array controller and the
12 second array controller;

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13      sending a write completion status to the host;

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14 sending the data to the remote storage system;

15 wherein, if the first controller fails before the data, for which said
16 completion status was sent to the host, is successfully copied to the remote storage
17 system, then

merging the data, stored on said log, with the backup copy in the remote storage system, in response to commands issued by the second array controller, by using the command information stored in the log to write the data associated therewith to the remote data storage system in the order in which each said write transaction originally occurred.

1 11. The method of claim 10, wherein, in the situation wherein both
2 controllers fail before the data, for which said completion status was sent to the
3 host, is successfully copied to the remote storage system, then after the first array
4 controller again becomes operational,

5 merging the data, stored on said log, with the backup copy in the remote
6 storage system, in response to commands issued by the first array controller, by
7 using the command information stored in the log to write the data associated
8 therewith to the remote data storage system in the order in which each said write
9 transaction originally occurred.

1 12. The method of claim 10, wherein the second controller communicates
2 with the first controller to determine when the first controller fails.

1 13. The method of claim 10, wherein the data written by the host computer
2 is written in asynchronous mode.

- 1 14. The method of claim 10, wherein the data for each write transaction
2 from the host computer is stored in cache memory in the first array controller in
3 transaction order.